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Social Care



UK Health
Security
Agency

Water fluoridation

Health monitoring report for England 2026

Appendix: data tables

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Risk factors included in analysis

Table A1. Available risk factors for inclusion in multivariable models, geographic level of availability, and data source for dental and hip fracture outcomes

Outcome	Available risk factors	Age band for adjustment	Unit of analysis	Source
Dental caries prevalence and severity score	Ethnicity, deprivation	N/A, all same age	LSOA	ONS/OHID IMD2019 (LSOA11/21): deprivation OHS: ethnicity
Tooth extractions	Age, ethnicity, deprivation, sex	0 to 4, 5 to 9, 10 to 14, 15 to 19 years old	LSOA	ONS Census 2021: age, sex, proportion from white backgrounds ONS/OHID IMD2019 (LSOA21): deprivation
Hip fractures	Age, ethnicity, deprivation, sex	0 to 49, 50 to 64, 65 to 79, ≥80 years old	LSOA	ONS Census 2021: age, sex, proportion from white backgrounds ONS/OHID IMD2019 (LSOA21): deprivation

Abbreviations

IMD = Index of Multiple Deprivation

LSOA = Lower-layer super output area

N/A = not applicable

OHID = Office for Health Improvement and Disparities

OHS = Oral health survey

ONS = Office for National Statistics

Table A2. Individual and area-based risk factor selection for the cognitive ability outcome

Risk factor category	Order of risk factor added into model for testing	Variable definition
Child and maternal characteristics	1. Child age at each sweep	Continuous (months)
	2. Child sex	Male; Female
	3. Low Birthweight	<2500g; ≥2500g
	4. Maternal ethnicity	White; Black British; Indian; Mixed; Bangladeshi/ Pakistani; Other
	5. Maternal age at birth of child	Continuous (years)
	6. Whether child was breastfed	Yes; No
	7. Language spoken in household	Only English; English plus other language
	8. Whether child was exposed to passive smoke at each sweep	Yes; No
Measures of socio-economic status at household and neighbourhood level [note 1]	9. OECD Income Weighted Quintiles	Quintiles
	10. Household's NVQ equivalent of highest academic qualification	No NVQ equivalent; Level 1; Level 2; Level 3; Level 4; Level 5
	11. IMD deciles	Deciles
	12. Study population stratum [note 2]	Advantaged; Disadvantaged; Ethnic
Child education [note 3]	13. Has child started school (sweep 3)	Yes; No
	14. Language and speech concerns (sweep 3)	Yes; No
	15. Statement of special needs (sweep 4)	Yes; No

Abbreviations

IMD= Index of Multiple Deprivation

NVQ = National Vocational Qualifications

OECD = Organization for Economic Cooperation and Development

Notes

Note 1: Area-based covariates were identified to account for socio-economic status at household and neighbourhood-level when assessing the cognitive ability outcome.

Note 2: Study population stratum as defined by the Millenium Cohort Study (coded as Ethnic – children living in wards where the proportion of ethnic minorities >30%; Disadvantaged – children living in the poorest 25% of wards according to the Child Poverty Index for England and Wales that are not in the Ethnic stratum, Advantaged – all other children).

Note 3: Child education status was included if the child had started school at sweep 3 (yes; no), as was if the child had any language and speech concerns (yes; no), and if the child had any special needs at sweep 4 (yes; no).

Oral health survey characteristics

Table A3. Distribution of 5 year old children in the 2022 oral health survey by IMD deciles

IMD decile	Oral health survey 2022		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
10 (least deprived)	5,716	9.1	59,300	9.1
9	5,898	9.4	58,800	9.0
8	6,119	9.8	58,800	9.0
7	5,744	9.1	58,400	9.0
6	6,072	9.7	60,500	9.3
5	5,870	9.4	62,200	9.6
4	6,086	9.7	64,000	9.8
3	6,690	10.7	69,100	10.6
2	7,050	11.3	74,500	11.5
1 (most deprived)	7,404	11.8	85,000	13.1
Total	62,649	100.0	650,700	100.0

Abbreviations

IMD = Index of Multiple Deprivation

ONS = Office for National Statistics

Notes

Note 1: General population counts are based on ONS 2022 mid-year estimates for 5 year olds and are rounded to the nearest hundred.

Note 2: Percentages may not sum to the total due to rounding.

Table A4. Distribution of 5 year old children in the 2022 oral health survey by ethnicity

Ethnicity	Oral health survey 2022		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
White	45,072	71.9	475,900	72.3
All other ethnic groups combined	15,188	24.2	182,800	27.8
Missing	2,389	3.8	--	--
Total	62,649	100.0	658,700	100.0

Abbreviations

IMD = Index of Multiple Deprivation

ONS = Office for National Statistics

Notes

Note 1: General population counts are based on ONS 2022 mid-year estimates for 5 year olds and are rounded to the nearest hundred.

Note 2: Percentages may not sum to the total due to rounding.

Table A5. Distribution of 5 year old children in the 2024 oral health survey by IMD deciles

IMD decile	Oral health survey 2024		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
10 (least deprived)	6,293	7.7	65,700	9.1
9	7,662	9.4	66,500	9.2
8	7,630	9.3	69,200	9.6
7	7,313	8.9	67,700	9.4
6	7,566	9.2	70,400	9.7
5	7,330	9.0	71,600	9.9
4	7,727	9.4	71,300	9.9
3	8,717	10.6	73,400	10.2
2	10,160	12.4	78,200	10.8
1 (most deprived)	11,507	14.1	88,900	12.3
Total	81,905	100.0	722,900	100.0

Abbreviations

IMD = Index of Multiple Deprivation

LSOA = Lower-layer super output area

ONS = Office for National Statistics

Notes

Note 1: General population counts are based on proportional allocation of the total ONS 2024 mid-year estimates for the 5 year old population according to the distribution of the population across LSOAs from the 2022 mid-year estimates. These counts are rounded to the nearest hundred.

Note 2: Percentages may not sum to the total due to rounding.

Table A6. Distribution of 5 year old children in the 2024 oral health survey by ethnicity

Ethnicity	Oral health survey 2024		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
White	57,653	70.4	475,900	72.3
All other ethnic groups combined	19,975	24.4	182,800	27.8
Missing	4,277	5.2	--	--
Total	81,905	100.0	658,700	100.0

Abbreviations

IMD = Index of Multiple Deprivation

LSOA = Lower-layer super output area

ONS = Office for National Statistics

Notes

Note 1: General population counts are based on proportional allocation of the total ONS 2024 mid-year estimates for the 5 year old population according to the distribution of the population across LSOAs from the 2022 mid-year-estimates. These counts are rounded to the nearest hundred.

Note 2: Percentages may not sum to the total due to rounding.

Table A7. Distribution of Year 6 children in the 2023 oral health survey by IMD deciles

IMD decile	Oral health survey 2023		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
10 (least deprived)	4,454	8.4	152,600	9.8
9	5,326	10.0	149,200	9.6
8	5,277	9.9	150,300	9.7
7	4,952	9.3	147,100	9.5
6	5,104	9.6	149,100	9.6
5	4,896	9.2	149,900	9.7
4	5,199	9.8	149,500	9.6

IMD decile	Oral health survey 2023		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
3	5,611	10.6	153,600	9.9
2	6,152	11.6	164,800	10.6
1 (most deprived)	6,102	11.5	184,400	11.9
Total	53,073	100.0	1,550,500	100.0

Abbreviations

IMD = Index of Multiple Deprivation

LSOA = Lower-layer super output area

ONS = Office for National Statistics

Note

Note 1: General population counts are based on proportional allocation of the total ONS 2023 mid-year estimates for the 5 year old population according to the distribution of the population across LSOAs from the 2022 mid-year estimates. These counts are rounded to the nearest hundred.

Table A8. Distribution of Year 6 children in the 2023 oral health survey by ethnicity

Ethnicity	Oral health survey 2023		General population	
	Number of children	Percentage of children	Number of children	Percentage of children
White	38,638	72.8	1,006,000	72.8
All other ethnic groups combined	12,879	24.3	376,200	27.2
Missing	1,556	2.9	--	--
Total	53,073	100.0	1,382,200	100.0

Abbreviations

IMD = Index of Multiple Deprivation

LSOA = Lower-layer super output area

ONS = Office for National Statistics

Notes

Note 1: General population counts are based on proportional allocation of the total ONS 2023 mid-year estimates for the 10 and 11 year old population according to the distribution of the population across LSOAs from the 2022 mid-year estimates. These counts are rounded to the nearest hundred.

Note 2: Percentages may not sum to the total due to rounding.

Descriptive statistics for risk factors

Table A9. Prevalence of dental caries experience (d₃mft >0) and dental caries severity score in 5 year olds for the 2022 oral health survey, by demographic characteristics

Factor	Children examined, N (%)	Children with dental caries experience, N (%)	Children with dental caries experience, % (95% CI)	Mean severity score per child (95% CI)
IMD quintile				
5 (least deprived)	11,614 (18.5)	1,570 (10.7)	13.5 (12.9, 14.2)	0.36 (0.35, 0.38)
4	11,863 (18.9)	2,011 (13.8)	17.0 (16.3, 17.6)	0.50 (0.49, 0.52)
3	11,942 (19.1)	2,499 (17.1)	20.9 (20.2, 21.7)	0.71 (0.69, 0.73)
2	12,776 (20.4)	3,455 (23.6)	27.0 (26.3, 27.8)	1.00 (0.97, 1.02)
1 (most deprived)	14,454 (23.1)	5,080 (34.8)	35.2 (34.4, 35.9)	1.39 (1.37, 1.41)
Ethnicity				
White	45,072 (71.9)	9,239 (63.2)	20.5 (20.1, 20.8)	0.67 (0.66, 0.68)
All other ethnic groups combined	15,188 (24.2)	4,785 (32.7)	31.5 (30.8, 32.3)	1.26 (1.23, 1.29)
Missing	2,389 (3.8)	591 (4.0)	24.7 (23.1, 26.5)	0.98 (0.90, 1.05)
Total	62,649 (100.0)	14,615 (100.0)	23.3 (23.0, 23.7)	0.82 (0.81, 0.83)

Abbreviations

CI = Confidence interval

d₃mft = decayed (at dentinal level), missing or filled primary teeth

IMD = Index of Multiple Deprivation

Note

Note 1: Percentages may not sum to the total due to rounding.

Table A10. Prevalence of dental caries experience (d₃mft >0) and mean dental caries severity score in 5 year olds for the 2024 oral health survey, by demographic characteristics

Factor	Children examined, N (%)	Children with dental caries experience, N (%)	Children with dental caries experience, % (95% CI)	Mean severity score per child (95% CI)
IMD quintile				
5 (least deprived)	13,955 (17.0)	1,891 (10.2)	13.6 (13.0, 14.1)	0.38 (0.37, 0.39)
4	14,943 (18.2)	2,488 (13.4)	16.7 (16.1, 17.3)	0.50 (0.49–0.51)
3	14,896 (18.2)	2,918 (15.7)	19.6 (19.0, 20.2)	0.65 (0.64–0.67)
2	16,444 (20.1)	4,303 (23.2)	26.2 (25.5, 26.8)	0.95 (0.94–0.97)
1 (most deprived)	21,667 (26.5)	6,971 (37.5)	32.2 (31.6, 32.8)	1.26 (1.24–1.28)
Ethnicity				
White	57,653 (70.4)	11,229 (60.5)	19.5 (19.2, 19.8)	0.60 (0.60, 0.60)
All other ethnic groups combined	19,975 (24.4)	6,180 (33.3)	30.9 (30.3, 31.6)	1.26 (1.20, 1.30)
Missing	4,277 (5.2)	1,162 (6.3)	27.2 (25.9, 28.5)	1.02 (0.97, 1.08)
Total	81,905 (100.0)	18,571 (100.0)	22.7 (22.4, 23.0)	0.80 (0.79, 0.81)

Abbreviations

CI = Confidence interval

d₃mft = decayed (at dentinal level), missing or filled primary teeth

IMD = Index of Multiple Deprivation

Notes

Note 1: Percentages may not sum to the total due to rounding.

Table A11. Prevalence of dental caries experience (d₃mft >0) and mean dental caries severity score in Year 6 children (10/11 year olds) for the 2023 oral health survey, by demographic characteristics

Factor	Children examined, N (%)	Children with dental caries experience, N (%)	Children with dental caries experience, % (95% CI)	Mean severity score per child (95% CI)
IMD quintile				
5 (least deprived)	9,780 (18.4)	1,019 (11.9)	10.4 (9.8, 11.0)	0.17 (0.17, 0.18)
4	10,229 (19.3)	1,291 (15.1)	12.6 (12.0, 13.3)	0.21 (0.21, 0.22)
3	10,000 (18.8)	1,448 (16.9)	14.5 (13.8, 15.2)	0.26 (0.25, 0.27)
2	10,810 (20.4)	1,942 (22.7)	18.0 (17.3, 18.7)	0.33 (0.32, 0.34)
1 (most deprived)	12,254 (23.1)	2,851 (33.3)	23.3 (22.5, 24.0)	0.46 (0.45, 0.47)
Ethnicity				
White	38,638 (72.8)	6,211 (72.6)	16.1 (15.7, 16.4)	0.29 (0.29, 0.30)
All other ethnic groups combined	12,879 (24.3)	2,095 (24.5)	16.3 (15.6, 16.9)	0.30 (0.29, 0.32)
Missing	1,556 (2.9)	245 (2.9)	15.8 (14.0, 17.6)	0.29 (0.26, 0.32)
Total	53,073 (100.0)	8,551 (100.0)	16.1 (15.8, 16.4)	0.30 (0.29, 0.30)

Abbreviations

CI = confidence interval

D3Mft = decayed (at dentinal level), missing or filled permanent teeth

IMD = Index of Multiple Deprivation

Note

Note 1: Percentages may not sum to the total due to rounding.

Table A12. Incidence rates for hospital admissions for caries-related tooth extractions in 0 to 19 year olds between April 2021 and March 2024, by age group, sex, IMD decile, and calendar year

Factor	Admissions, N (%)	PYAR, person-years (%)	Incidence per 100,000 PYAR (95% CI)
Age group, years			
0 to 4	12,019 (13.8)	9,477,197 (23.2)	127 (125, 129)
5 to 9	50,590 (58.0)	10,353,600 (25.3)	489 (485, 493)
10 to 15	18,696 (21.4)	10,802,884 (26.4)	173 (171, 175)
15 to 19	5,930 (6.8)	10,293,080 (25.2)	58 (57, 59)
Sex			
Male	40,231 (46.1)	19,948,289 (48.7)	202 (200, 204)
Female	47,004 (53.9)	20,978,472 (51.3)	224 (222, 226)
IMD quintile			
5 (least deprived)	7,763 (8.9)	7,672,404 (18.8)	101 (99, 103)
4	10,845 (12.4)	7,566,039 (18.5)	143 (140, 146)
3	13,687 (15.7)	7,796,297 (19.1)	176 (173, 179)
2	20,764 (23.8)	8,303,875 (20.3)	250 (247, 253)
1 (most deprived)	34,176 (39.2)	9,588,146 (23.4)	356 (352, 360)
Calendar year			
2021	19,599 (22.5)	10,231,690 (25.0)	192 (189, 195)
2022	29,629 (34.0)	13,642,254 (33.3)	217 (215, 219)
2023	30,621 (35.1)	13,642,254 (33.3)	224 (222, 227)
2024	7,386 (8.5)	3,410,563 (8.3)	217 (212, 222)
Total	87,235 (100.0)	40,926,761 (100.0)	213 (212, 214)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

PYAR = person-years at risk

Notes

Note 1: Calendar years were adjusted for in models. However, admissions were extracted from HES based on financial year, meaning data represents only 9 months of 2021 and 3 months of 2024. PYAR may not sum exactly due to rounding.

Note 2: Percentages may not sum to the total due to rounding.

Table A13. Incidence rates for hospital admissions for hip fractures in people of any age between April 2021 and March 2024, by age group, sex, IMD decile, and calendar year

Factor	Admissions, N (%)	PYAR, person-years (%)	Incidence per 100,000 PYAR (95% CI)
Age group, years			
0 to 49	4,830 (2.4)	109,610,299 (61.4)	4 (4, 4)
50 to 64	13,923 (7.0)	34,781,500 (19.5)	40 (39, 41)
65 to 79	57,101 (28.6)	25,167,025 (14.1)	227 (225, 229)
≥80	124,025 (62.1)	9,052,153 (5.1)	1,370 (1362, 1378)
Sex			
Male	63,657 (31.9)	87,310,137 (48.9)	73 (72, 74)
Female	136,222 (68.2)	91,300,839 (51.1)	149 (148, 150)
IMD quintile			
5 (least deprived)	42,487 (21.3)	34,989,073 (19.6)	121 (120, 122)
4	43,277 (21.7)	35,892,646 (20.1)	121 (120, 122)
3	41,092 (20.6)	36,524,662 (20.5)	113 (112, 114)
2	36,961 (18.5)	35,958,968 (20.1)	103 (102, 104)
1 (most deprived)	36,062 (18.0)	35,245,629 (19.7)	102 (101, 103)
Calendar year			
2021	49,626 (24.8)	44,591,764 (25.0)	111 (110, 112)
2022	68,181 (34.1)	59,594,337 (33.4)	114 (113, 115)
2023	68,222 (34.1)	59,598,509 (33.4)	114 (113, 115)
2024	13,850 (6.9)	14,826,366 (8.3)	93 (91, 95)
Total	199,879 (100.0)	178,610,976 (100.0)	112 (112, 112)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

PYAR = person-years at risk

Notes

Note 1: Calendar years were adjusted for in models. However, admissions were extracted from HES based on financial year, meaning data represents only 9 months of 2021 and 3 months of 2024. PYAR may not sum exactly due to rounding.

Note 2: Percentages may not sum to the total due to rounding.

Table A14. Distribution of children at age 5 and age 7 in the Millenium Cohort Study by selected sociodemographic characteristics

Factor	Age 5, N (%)	Age 7, N (%)
Sex		
Female	3,890 (49.5)	3,395 (49.5)
Male	3,982 (50.5)	3,403 (50.5)
Birthweight		
Low birthweight (<2500g)	603 (7.0)	509 (7.0)
Normal birthweight (≥2500g)	7,269 (93.0)	6,289 (93.0)
Breastfeeding status		
No	2,029 (26.8)	1,694 (28.5)
Yes	5,843 (73.2)	5,104 (71.5)
Exposure to smoke in the home		
No	6,824 (86.3)	5,996 (87.5)
Yes	1,048 (13.7)	802 (12.5)
Child interview age in months, mean (SD)	62.4 (2.9)	86.69 (3.0)
Mother's age in years at childbirth, mean (SD)	28.9 (5.8)	28.73 (58)

Abbreviations

g = grams

PYAR = person-years at risk

SD = standard deviation

Notes

Note 1: 5 and 7 year olds were surveyed in sweep 3 and sweep 4, respectively.

Note 2: Percentages may not sum to the total due to rounding.

Full adjusted model tables

Table A15. Adjusted odds ratios for the association between drinking water fluoride concentration and dental caries experience (d₃mft >0) in 5 year olds in 2022 and 2024

Factor	Adjusted OR (95% CI)	
	2022	2024
Mean fluoride concentration, mg/L		
<0.10	1.00	1.00
0.10 to 0.19	0.92 (0.84, 1.02)	0.97 (0.89, 1.05)
0.20 to 0.39	0.93 (0.83, 1.04)	0.78 (0.71, 0.86)
0.40 to 0.69	0.74 (0.63, 0.87)	0.71 (0.63, 0.81)
≥0.70	0.73 (0.63, 0.85)	0.56 (0.50, 0.63)
IMD quintile		
5 (least deprived)	1.00	1.00
4	1.38 (1.25, 1.51)	1.27 (1.17, 1.39)
3	1.88 (1.72, 2.06)	1.57 (1.44, 1.70)
2	2.55 (2.34, 2.79)	2.27 (2.09, 2.45)
1 (most deprived)	3.85 (3.52, 4.22)	3.01 (2.79, 3.26)
Ethnicity		
White	1.00	1.00
All other ethnic groups combined	1.69 (1.60, 1.78)	1.69 (1.61, 1.77)
Continuous	0.93 (0.91, 0.95)	0.91 (0.89, 0.92)

Abbreviations

CI = confidence interval

d₃mft = decayed (at dentinal level), missing or filled primary teeth

IMD = Index of Multiple Deprivation

mg/L = milligrams per litre

OR = odds ratio

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A16. Adjusted regression coefficients for the association between drinking water fluoride concentration and experiencing a given category of dental caries severity score, in 5 year olds in 2022

Factor	Adjusted beta (95% CI)		
	Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest vs medium, low or zero severity score category
Mean fluoride concentration, mg/L			
<0.10	0.00	0.00	0.00
0.10 to 0.19	-0.15 (-0.26, -0.04)	-0.22 (-0.33, -0.10)	-0.16 (-0.28, -0.03)
0.20 to 0.39	-0.17 (-0.30, -0.03)	-0.23 (-0.36, -0.09)	-0.17 (-0.32, -0.02)
0.40 to 0.69	-0.25 (-0.42, -0.07)	-0.54 (-0.73, -0.35)	-0.60 (-0.82, -0.38)
≥0.70	-0.39 (-0.56, -0.21)	-0.49 (-0.67, -0.31)	-0.54 (-0.74, -0.34)
IMD quintile			
5 (least deprived)	0.00	0.00	0.00
4	0.21 (0.11, 0.31)	0.39 (0.27, 0.51)	0.44 (0.28, 0.59)
3	0.46 (0.36, 0.56)	0.69 (0.58, 0.81)	0.75 (0.60, 0.90)
2	0.80 (0.70, 0.89)	1.04 (0.93, 1.16)	1.10 (0.96, 1.25)
1 (most deprived)	1.20 (1.10, 1.30)	1.47 (1.36, 1.59)	1.55 (1.40, 1.69)
Ethnicity			
White	0.00	0.00	0.00
All other ethnic groups combined	0.04 (-0.02, 0.11)	-0.45 (-0.52, -0.38)	-0.61 (-0.68, -0.53)
Continuous	-0.07 (-0.11, -0.04)	-0.10 (-0.14, -0.07)	-0.12 (-0.15, -0.08)

Abbreviations

CI = confidence interval

IMD – Index of Multiple Deprivation

mg/L = milligrams per litre

OR = odds ratio

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 4: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 5: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A17. Adjusted regression coefficients for the association between drinking water fluoride concentration and experiencing a given category of dental caries severity score, in 5 year olds in 2024

Factor	Adjusted beta (95% CI)		
	Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest vs medium, low or zero severity score category
<0.10	0.00	0.00	0.00
0.10 to 0.19	-0.08 (-0.18, 0.02)	-0.08 (-0.18, 0.03)	-0.13 (-0.24, -0.01)
0.20 to 0.39	-0.09 (-0.21, 0.03)	-0.24 (-0.36, -0.11)	-0.35 (-0.49, -0.21)
0.40 to 0.69	-0.23 (-0.39, -0.07)	-0.48 (-0.66, -0.30)	-0.58 (-0.79, -0.37)
≥0.70	-0.19 (-0.34, -0.04)	-0.70 (-0.86, -0.54)	-1.01 (-1.20, -0.83)
IMD quintile			
5	0.00	0.00	0.00
4	0.24 (0.15, 0.33)	0.28 (0.17, 0.39)	0.30 (0.16, 0.45)
3	0.42 (0.33, 0.51)	0.54 (0.43, 0.64)	0.57 (0.43, 0.71)
2	0.73 (0.64, 0.82)	0.89 (0.79, 1.00)	0.93 (0.79, 1.06)
1	1.03 (0.94, 1.12)	1.22 (1.11, 1.32)	1.16 (1.03, 1.30)
Ethnicity			
White	0.00	0.00	0.00
All other ethnic groups combined	0.08 (0.02, 0.14)	-0.41 (-0.47, -0.35)	-0.75 (-0.82, -0.67)
Continuous	-0.03 (-0.06, -0.01)	-0.14 (-0.17, -0.11)	-0.22 (-0.26, -0.17)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

mg/L = milligrams per litre

OR = odds ratio

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 4: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 5: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A18. Adjusted incidence rate ratios for the association between drinking water fluoride concentration and caries-related tooth extraction, in 0 to 19 year olds between April 2021 and March 2024

Factor	Adjusted IRR (95% CI)
Mean fluoride concentration, mg/L	
<0.10	1.00
0.10 to 0.19	1.02 (0.98, 1.05)
0.20 to 0.39	0.91 (0.86, 0.96)
0.40 to 0.69	0.80 (0.76, 0.86)
≥0.70	0.72 (0.66, 0.78)
Age group	
0 to 4	1.00
5 to 9	3.90 (3.82, 3.98)
10 to 15	1.41 (1.38, 1.45)
15 to 19	0.47 (0.46, 0.49)
Sex	
Male	1.00
Female	0.89 (0.88, 0.91)
Ethnicity	
Per 10% increase in proportion of LSOA from white backgrounds	1.06 (1.05, 1.06)
IMD quintile	
5 (least deprived)	1.00
4	1.40 (1.36, 1.45)
3	1.76 (1.71, 1.82)
2	2.35 (2.28, 2.42)

Factor	Adjusted IRR (95% CI)
1 (most deprived)	3.10 (3.01, 3.19)
Calendar year	
2021	0.86 (0.84, 0.87)
2022	0.97 (0.95, 0.99)
2023	1.00
2024	0.96 (0.94, 0.99)
Continuous	0.93 (0.91, 0.94)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

IRR = incidence rate ratio

mg/L = milligrams per litre

Notes

Note 1: The model was adjusted for deprivation, age group, sex, calendar year, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration is calculated as the mean of annual mean values in the five years preceding the hospital admission.

Note 3: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A19. Adjusted incidence rate ratios for the association between drinking water fluoride concentration and emergency admissions for hip fracture in people of all ages between April 2021 and March 2024

Factor	Adjusted IRR (95% CI)
Mean fluoride concentration, mg/L	
<0.10	1.00
0.10 to 0.19	0.98 (0.94, 1.00)
0.20 to 0.39	1.01 (0.99, 1.03)
0.40 to 0.69	1.02 (1.00, 1.04)
≥0.70	1.05 (1.02, 1.09)
Age group	
0 to 49	1.00
50 to 64	1.84 (1.82, 1.86)
65 to 79	49.24 (47.75, 50.77)
≥80	290.42 (281.62, 299.08)
Sex	

Factor	Adjusted IRR (95% CI)
Male	1.00
Female	1.62 (1.61, 1.64)
Ethnicity	
Per 10% increase in proportion of LSOA from white backgrounds	1.06 (1.05, 1.06)
IMD quintile	
5 (least deprived)	1.00
4	1.08 (1.07, 1.10)
3	1.15 (1.14, 1.17)
2	1.30 (1.27, 1.32)
1 (most deprived)	1.58 (1.55, 1.60)
Calendar year	
2021	0.97 (0.96, 0.99)
2022	1.00 (0.99, 1.01)
2023	1.00
2024	0.82 (0.80, 0.84)
Fluoride concentration, continuous	1.01 (1.00, 1.02)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

IRR = incidence rate ratio

mg/L = milligrams per litre

Notes

Note 1: The model was adjusted for age group, sex, IMD quintile, calendar year, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration is calculated as the mean of annual mean values in the ten years preceding the year of the hospital admission.

Note 3: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A20. Adjusted regression coefficients for the association between drinking water fluoride concentration and difference in cognitive ability test scores in 5 and 7 year olds in the Millenium Cohort Study

Factor	Difference in standardised test score, Adjusted beta (95% CI)					
	BAS-NV	BAS-PC	BAS-PS	BAS-WR	BAS-PC	NFER-PiM
Annual mean fluoride at 9 months old (per IQR 0.13 mg/L increase)	0.10 (-0.03, 0.23)	0.04 (-0.09, 0.17)	-0.11 (-0.25, 0.03)	-0.06 (-0.28, 0.16)	-0.01 (-0.15, 0.14)	0.09 (-0.14, 0.33)
Sex						
Male	0.00	0.00	0.00	0.00	0.00	0.00
Female	0.40 (-0.01, 0.82)	1.47 (1.07, 1.87)	1.06 (0.64, 1.49)	1.81 (1.06, 2.56)	0.07 (-0.41, 0.55)	-1.31 (-1.98, -0.63)
Ethnicity						
White	0.00	0.00	0.00	0.00	0.00	0.00
Black or Black British	-7.12 (-8.22, -6.03)	-3.61 (-4.61, -2.61)	0.03 (-1.09, 1.15)	1.88 (-0.09, 3.84)	-5.49 (-6.77, -4.20)	-2.23 (-4.06, -0.39)
Indian	-6.18 (-7.36, -4.99)	-0.73 (-1.67, 0.22)	0.00 (-1.22, 1.22)	5.01 (3.17, 6.86)	-1.45 (-2.70, -0.20)	0.66 (-1.37, 2.69)
Mixed	-3.64 (-5.73, -1.54)	-2.93 (-4.98, -0.89)	-0.57 (-2.78, 1.65)	-0.79 (-4.22, 2.64)	-1.58 (-4.17, 1.02)	1.20 (-2.08, 4.48)
Pakistani and Bangladeshi	-10.93 (-11.91, -9.96)	-2.35 (-3.19, -1.51)	-1.92 (-2.83, -1.00)	3.08 (1.41, 4.76)	-2.64 (-3.81, -1.46)	-5.29 (-6.92, -3.67)
Other ethnic groups	-10.07 (-11.84, -8.30)	-0.07 (-1.46, 1.31)	0.71 (-0.84, 2.26)	4.02 (1.44, 6.60)	0.26 (-1.55, 2.06)	-0.42 (-3.06, 2.23)
Mother's age						
Age (years) – power of one	0.25 (-0.06, 0.56)		0.37 (0.05, 0.69)			0.35 (-0.16, 0.86)
Age (years) – power of two	-0.00 (-0.01, 0.00)		-0.01 (-0.01, -0.00)			-0.01 (-0.02, 0.00)
Breastfeeding status						
Breastfed	0.00	0.00	0.00	0.00	0.00	0.00
Never breastfed	-0.92 (-1.43, -0.41)	-0.84 (-1.33, -0.34)	-1.19 (-1.71, -0.67)	-1.86 (-2.77, -0.96)	-1.20 (-1.78, -0.62)	-1.19 (-2.01, -0.36)
OECD quintile						
Lowest quintile	-4.01 (-4.89, -3.13)	-2.10 (-2.92, -1.28)	-1.28 (-2.15, -0.42)	-7.03 (-8.49, -5.57)	-2.79 (-3.78, -1.81)	-6.61 (-8.00, -5.22)
Second quintile	-3.06 (-3.85, -2.26)	-1.66 (-2.41, -0.90)	-1.37 (-2.16, -0.58)	-6.13 (-7.46, -4.81)	-2.60 (-3.50, -1.70)	-5.12 (-6.36, -3.88)
Third quintile	-1.54 (-2.28, -0.80)	-1.13 (-1.84, -0.43)	-0.85 (-1.59, -0.10)	-3.18 (-4.43, -1.94)	-1.09 (-1.93, -0.26)	-2.98 (-4.14, -1.81)
Fourth quintile	-1.13 (-1.81, -0.44)	-0.78 (-1.44, -0.12)	-1.08 (-1.78, -0.38)	-2.06 (-3.21, -0.91)	-0.89 (-1.66, -0.11)	-2.62 (-3.69, -1.55)
Highest quintile	0.00	0.00	0.00	0.00	0.00	0.00
Has child started school						
Yes	0.00	0.00				
No	-2.13 (-4.48, 0.22)	-2.48 (-4.75, -0.20)				
Does child have speech language concerns						
No	0.00	0.00	0.00			
Yes	-5.22 (-5.92, -4.52)	-3.16 (-3.89, -2.42)	-2.38 (-3.07, -1.69)			

Factor	Difference in standardised test score, Adjusted beta (95% CI)					
	BAS-NV	BAS-PC	BAS-PS	BAS-WR	BAS-PC	NFER-PiM
IMD decile						
1 (most deprived)	0.00	0.00			0.00	
2	0.29 (-0.59, 1.18)	0.39 (-0.48, 1.25)			0.76 (-0.34, 1.86)	
3	0.12 (-0.79, 1.04)	0.76 (-0.15, 1.68)			1.72 (0.58, 2.86)	
4	0.23 (-0.75, 1.21)	0.70 (-0.30, 1.70)			0.70 (-0.52, 1.91)	
5	0.53 (-0.48, 1.53)	-0.14 (-1.15, 0.86)			0.66 (-0.53, 1.86)	
6	0.85 (-0.21, 1.92)	1.17 (0.09, 2.26)			1.61 (0.34, 2.88)	
7	0.59 (-0.52, 1.70)	1.92 (0.77, 3.08)			2.53 (1.20, 3.86)	
9	1.72 (0.59, 2.85)	1.32 (0.17, 2.46)			1.35 (0.01, 2.68)	
9	1.43 (0.28, 2.58)	1.22 (0.04, 2.40)			1.87 (0.54, 3.21)	
10 (least deprived)	1.08 (-0.04, 2.20)	1.84 (0.67, 3.01)			2.31 (0.96, 3.67)	
Does child have special needs?						
No				0.00	0.00	0.00
Yes				-14.14 (-15.86, -12.41)	-5.34 (-6.48, -4.19)	-10.31 (-11.71, -8.91)
Child interview age in months						
Age (months) – power of one	-4.83 (-7.35, -2.32)	57.10 (5.96, 108.23)	-0.16 (-0.24, -0.09)	-0.47 (-0.60, -0.34)	4.07 (0.25, 7.88)	-8.37 (-13.77, -2.97)
Age (months) – power of two	0.04 (0.02, 0.06)	-0.90 (-1.71, -0.08)			-0.02 (-0.05, -0.00)	0.05 (0.01, 0.08)
Age (months) – power of three		0.00 (0.00, 0.01)				
Highest parental academic qualification (NVQ equivalent)						
NVQ level 2	0.00	0.00	0.00	0.00	0.00	0.00
No NVQ equivalent/has overseas qualification	-3.47 (-4.24, -2.70)	-2.00 (-2.73, -1.27)	-0.91 (-1.67, -0.14)	-2.28 (-3.73, -0.83)	-1.68 (-2.57, -0.80)	-1.80 (-3.07, -0.52)
NVQ level 1	-1.22 (-2.02, -0.41)	-1.57 (-2.42, -0.73)	-1.57 (-2.37, -0.77)	-3.49 (-4.99, -1.98)	-2.22 (-3.18, -1.26)	-2.26 (-3.66, -0.87)
NVQ level 3	1.19 (0.44, 1.94)	0.89 (0.16, 1.62)	1.57 (0.77, 2.37)	3.50 (2.14, 4.87)	1.56 (0.70, 2.42)	1.98 (0.75, 3.21)
NVQ level 4	2.95 (2.36, 3.53)	1.45 (0.90, 2.00)	1.54 (0.95, 2.13)	4.72 (3.70, 5.74)	2.05 (1.38, 2.72)	3.22 (2.29, 4.15)
NVQ level 5 (highest)	4.05 (3.05, 5.05)	1.69 (0.76, 2.61)	3.09 (2.10, 4.08)	8.17 (6.64, 9.71)	2.68 (1.60, 3.77)	6.33 (4.84, 7.83)
Birthweight						
Normal birthweight (>=2500g)		0.00	0.00	0.00	0.00	0.00
Low birthweight (<2500g)		-1.95 (-2.72, -1.19)	-0.59 (-1.40, 0.22)	-2.60 (-4.04, -1.17)	-2.36 (-3.28, -1.44)	-3.82 (-5.12, -2.51)
Maternal smoking status						
Non-smoker	0.00			0.00		
Smoker	-0.53 (-1.17, 0.11)			-3.18 (-4.39, -1.97)		

Abbreviations

CI = confidence interval

BAS = British Ability Scale

BAS-NV = BAS Naming Vocabulary

BAS-PC = BAS Pattern Construction

BAS-PS = BAS Picture Similarities

BAS-WR = BAS Word Reading

IMD = Index of Multiple Deprivation

IQR = interquartile range

mg/L = milligrams per litre

NFER-PiM = National Foundation for Educational Research Progress in Maths

OECD = Organization for Economic Cooperation and Development

Notes

Note 1: Difference compared to the lowest group (<0.10 mg/L, categorical exposure) or difference per IQR increase (0.13 mg/L, continuous exposure) in drinking water fluoride exposure, adjusted for other common risk factors: age at interview, sex, maternal ethnicity, breastfeeding status, OECD income-weighted quintiles, highest parental academic qualification, sample weights, and clustering. In addition to the common risk factors, each cognitive ability test was adjusted for further factors: BAS-NV (maternal age at childbirth, exposure to smoke, IMD deciles, child started school, speech/language concerns), BAS-PC at age 5 (birthweight, IMD deciles, child started school, speech/language concerns), BAS-PS (birthweight, maternal age at childbirth, speech/language concerns), BAS-WR (birthweight, exposure to smoke, child has special needs), BAS-PC at age 7 (IMD deciles, child has special needs), NFER-PiM (birthweight, maternal age at childbirth, child has special needs).

Note 2: Mean fluoride exposure was measured for the area that child lived when they were approximately 9 months old.

Tables for the predicated prevalences and rates for health outcomes across categories of fluoride

Table A21. Model-predicted prevalence for dental caries experience (d₃mft >0) in 5 year olds in the 2022 and 2024 oral health surveys, by drinking water fluoride concentration, stratified by IMD quintile

IMD quintile	Mean fluoride concentration, mg/L	Predicted prevalence (95% CI)	
		2022	2024
5 (least deprived)	<0.10	13.0 (11.8, 14.4)	13.7 (12.5, 15.1)
	0.10 to 0.19	12.3 (11.2, 13.5)	13.5 (12.4, 14.7)
	0.20 to 0.39	11.5 (10.1, 13.0)	12.5 (11.2, 13.9)
	0.40 to 0.69	10.4 (8.0, 13.5)	11.1 (9.0, 13.5)
	≥0.70	10.7 (8.6, 13.2)	8.8 (7.4, 10.5)
4	<0.10	17.4 (16.0, 18.9)	16.9 (15.6, 18.3)
	0.10 to 0.19	14.4 (13.2, 15.8)	15.9 (14.7, 17.2)
	0.20 to 0.39	15.2 (13.6, 16.9)	14.2 (12.8, 15.5)
	0.40 to 0.69	12.5 (10.2, 15.3)	12.0 (9.8, 14.5)
	≥0.70	10.3 (8.3, 12.6)	12.5 (10.8, 14.3)
3	<0.10	19.1 (17.6, 20.7)	17.7 (16.4, 19.2)
	0.10 to 0.19	19.1 (17.7, 20.6)	19.4 (18.1, 20.8)
	0.20 to 0.39	17.5 (15.8, 19.4)	16.9 (15.4, 18.5)
	0.40 to 0.69	15.0 (12.5, 17.8)	15.0 (12.7, 17.7)
	≥0.70	16.4 (13.9, 19.4)	13.9 (12.3, 15.7)
2	<0.10	23.9 (22.3, 25.7)	24.1 (22.5, 25.7)
	0.10 to 0.19	24.4 (22.8, 26.1)	24.6 (23.1, 26.1)
	0.20 to 0.39	21.9 (19.9, 24.1)	21.5 (19.8, 23.3)
	0.40 to 0.69	19.5 (16.8, 22.5)	20.6 (17.5, 22.8)
	≥0.70	22.6 (19.6, 26.0)	16.1 (14.4, 18.0)
1 (most deprived)	<0.10	36.3 (34.4, 38.3)	32.1 (30.4, 33.8)
	0.10 to 0.19	26.9 (24.9, 29.8)	28.2 (26.5, 30.0)
	0.20 to 0.39	30.7 (27.5, 33.5)	25.5 (23.6, 27.5)
	0.40 to 0.69	25.2 (22.1, 28.5)	24.3 (21.5, 27.2)
	≥0.70	25.3 (22.5, 28.2)	20.0 (18.1, 21.9)

Abbreviations

CI = confidence interval

d3mft = decayed, missing or filled primary teeth

LAD = local authority district

IMD = Index of Multiple Deprivation

mg/L = milligrams per litre

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district. The model-predicted prevalences are displayed at the reference level for ethnicity which is white in this figure.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Table A22. Model-predicted incidence rates for hospital admissions for tooth extractions in 0 to 19 year olds, by drinking water fluoride concentration, stratified by IMD quintile

IMD quintile	Mean fluoride concentration, mg/L	Predicted incidence rate (95% CI)
5 (least deprived)	<0.10	152 (135, 171)
	0.10 to 0.19	167 (143, 180)
	0.20 to 0.39	157 (138, 178)
	0.40 to 0.69	140 (119, 165)
	≥0.70	125 (104, 150)
4	<0.10	215 (192, 241)
	0.10 to 0.19	230 (205, 257)
	0.20 to 0.39	208 (184, 236)
	0.40 to 0.69	178 (152, 208)
	≥0.70	175 (150, 204)
3	<0.10	271 (243, 304)
	0.10 to 0.19	291 (260, 325)
	0.20 to 0.39	269 (238, 304)
	0.40 to 0.69	214 (185, 247)
	≥0.70	189 (162, 220)
2	<0.10	374 (335, 418)
	0.10 to 0.19	382 (342, 426)
	0.20 to 0.39	311 (275, 351)
	0.40 to 0.69	288 (252, 330)
	≥0.70	277 (240, 320)

IMD quintile	Mean fluoride concentration, mg/L	Predicted incidence rate (95% CI)
1 (most deprived)	<0.10	506 (453, 565)
	0.10 to 0.19	480 (429, 536)
	0.20 to 0.39	427 (379, 481)
	0.40 to 0.69	396 (348, 449)
	≥0.70	335 (292, 384)

Abbreviations

CI = confidence interval

LAD = local authority district

LSOA = Lower-layer super output area

IMD = Index of Multiple Deprivation

mg/L = milligrams per litre

Notes

Note 1: The model was adjusted for deprivation, age groups, sex, calendar year, ethnicity and for residual clustering by local authority district. The model-predicted incidence rates are displayed at reference levels set for these factors, which is age group 5 to 9 years, male, admitted in 2023, at the mean proportion of children from white backgrounds.

Note 2: Mean fluoride concentration is calculated as the mean of annual mean values in the five years preceding the hospital admission.

Table A23. Model-predicted incidence rates of hospital admissions for hip fractures in people of any age, by drinking water fluoride concentration, stratified by age group

Age, years	Mean fluoride concentration, mg/L	Predicted incidence rate (95% CI)	
		Female	Male
0 to 49	<0.10	3 (2, 3)	5 (5, 6)
	0.10 to 0.19	2 (2, 2)	5 (4, 5)
	0.20 to 0.39	2 (2 - 3)	5 (4, 5)
	0.40 to 0.69	2 (2, 3)	5 (4, 6)
	≥0.70	3 (3, 3)	5 (4, 6)
50 to 64	<0.10	41 (40, 43)	30 (29, 32)
	0.10 to 0.19	37.22 (36, 39)	27 (25, 28)
	0.20 to 0.39	38.62 (36, 41)	26 (24, 28)
	0.40 to 0.69	41.93 (38, 46)	27 (24, 30)
	≥0.70	42.04 (39, 46)	29 (26, 32)
65 to 79	<0.10	251 (243, 258)	133 (127, 138)
	0.10 to 0.19	245 (238, 252)	131 (126, 136)

Age, years	Mean fluoride concentration, mg/L	Predicted incidence rate (95% CI)	
		Female	Male
	0.20 to 0.39	252 (242, 262)	131 (125, 139)
	0.40 to 0.69	254 (240, 268)	132 (123, 143)
	≥0.70	266 (253, 279)	149 (140, 160)
≥80	<0.10	1,445 (1,406, 1,485)	789 (760, 818)
	0.10 to 0.19	1,448 (1,410, 1,487)	787 (759, 816)
	0.20 to 0.39	1,479 (1,430, 1,530)	837 (800, 875)
	0.40 to 0.69	1,533 (1,467, 1,602)	816 (781, 853)
	≥0.70	1,513 (1,448, 1,581)	829 (781, 879)

Abbreviations

CI = confidence interval

LAD = local authority district

LSOA = Lower-layer super output area

IMD = Index of Multiple Deprivation

mg/L = milligrams per litre

Notes

Note 1: The model was adjusted for deprivation, age groups, sex, calendar year, ethnicity and for residual clustering by local authority district. The model-predicted incidence rates are displayed at reference levels set for these factors, which the least deprived areas (IMD quintile 5), admitted in 2023, at the mean proportion of people from white backgrounds.

Note 2: Mean fluoride concentration is calculated as the mean of annual mean values in the five years preceding the hospital admission.

Full tables for dental caries severity score analyses

Dental caries severity score in 5 year olds in 2022

Table A24. Adjusted regression coefficients for the association between drinking water fluoride concentration and experiencing a given category of dental caries severity score, in 5 year olds in 2022, by deprivation group

IMD quintile	Mean fluoride concentration, mg/L	Adjusted beta (95% CI): low, medium or highest versus zero severity score category	Adjusted beta (95% CI): medium or highest versus low or zero severity score category	Adjusted beta (95% CI): highest versus medium, low or zero severity score category
5 (least deprived)	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.14 (-0.34, 0.05)	-0.07 (-0.30, 0.17)	-0.05 (-0.36, 0.26)
	0.20 to 0.39	-0.17 (-0.40, 0.06)	-0.15 (-0.44, 0.13)	0.07 (-0.30, 0.43)
	0.40 to 0.69	-0.13 (-0.52, 0.25)	-0.54 (-1.12, 0.03)	-0.39 (-1.15, 0.38)
	≥0.70	-0.35 (-0.69, -0.02)	-0.32 (-0.76, 0.11)	-0.62 (-1.28, 0.05)
	Continuous	-0.08 (-0.12, -0.03)	-0.12 (-0.16, -0.08)	-0.13 (-0.17, -0.08)
4	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.27 (-0.58, 0.03)	-0.24 (-0.61, 0.12)	-0.14 (-0.63, 0.35)
	0.20 to 0.39	-0.26 (-0.62, 0.10)	-0.20 (-0.64, 0.24)	-0.18 (-0.76, 0.39)
	0.40 to 0.69	-0.47 (-1.08, 0.14)	-0.40 (-1.28, 0.49)	-0.76 (-1.97, 0.45)
	≥0.70	-0.43 (-0.93, 0.07)	-0.89 (-1.59, -0.18)	-0.98 (-2.04, 0.08)
	Continuous	-0.07 (-0.13, -0.00)	-0.06 (-0.13, 0.01)	-0.08 (-0.16, -0.00)
3	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.01 (-0.31, 0.29)	-0.01 (-0.38, 0.35)	-0.02 (-0.50, 0.46)
	0.20 to 0.39	-0.08 (-0.44, 0.28)	-0.05 (-0.49, 0.39)	-0.20 (-0.77, 0.37)
	0.40 to 0.69	-0.13 (-0.73, 0.47)	-0.41 (-1.28, 0.46)	-0.21 (-1.36, 0.93)
	≥0.70	-0.22 (-0.74, 0.30)	-0.38 (-1.05, 0.28)	-0.51 (-1.52, 0.49)
	Continuous	-0.05 (-0.11, 0.02)	-0.09 (-0.16, -0.02)	-0.10 (-0.19, -0.01)
2	<0.10	0.00	0.00	0.00
	0.10 to 0.19	0.08 (-0.22, 0.38)	0.02 (-0.33, 0.38)	0.08 (-0.39, 0.55)
	0.20 to 0.39	-0.08 (-0.43, 0.28)	-0.17 (-0.60, 0.27)	-0.18 (-0.74, 0.38)

IMD quintile	Mean fluoride concentration, mg/L	Adjusted beta (95% CI): low, medium or highest versus zero severity score category	Adjusted beta (95% CI): medium or highest versus low or zero severity score category	Adjusted beta (95% CI): highest versus medium, low or zero severity score category
	0.40 to 0.69	-0.16 (-0.75, 0.43)	-0.56 (-1.42, 0.29)	-0.73 (-1.88, 0.41)
	≥0.70	-0.21 (-0.73, 0.32)	-0.07 (-0.72, 0.58)	-0.11 (-1.09, 0.87)
	Continuous	-0.13 (-0.20, -0.05)	-0.14 (-0.22, -0.06)	-0.17 (-0.27, -0.07)
1 (most deprived)	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.41 (-0.72, -0.10)	-0.58 (-0.94, -0.22)	-0.49 (-0.96, -0.02)
	0.20 to 0.39	-0.21 (-0.58, 0.15)	-0.33 (-0.76, 0.11)	-0.12 (-0.67, 0.42)
	0.40 to 0.69	-0.29 (-0.88, 0.29)	-0.62 (-1.46, 0.23)	-0.68 (-1.79, 0.44)
	≥0.70	-0.74 (-1.28, -0.21)	-0.63 (-1.27, 0.004)	-0.64 (-1.60, 0.32)
	Continuous	-0.06 (-0.14, 0.02)	-0.09 (-0.18, 0.003)	-0.11 (-0.22, 0.01)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

LAD = local authority district

mg/L = milligrams per litre

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 4: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 5: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A25. Adjusted regression coefficients for the association between fluoridation schemes status and experiencing the highest category of dental caries severity score in 5 year olds in the 2022 oral health survey, by deprivation group

IMD quintile	Fluoridation scheme	Adjusted beta (95% CI)		
		Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest versus medium, low or zero severity score category
All	No	0.00	0.00	0.00
	Yes	-0.27 (-0.42, -0.12)	-0.39 (-0.55, -0.23)	-0.47 (-0.64, -0.29)
5 (least deprived)	No	0.00	0.00	0.00
	Yes	-0.26 (-0.53, 0.003)	-0.36 (-0.70, -0.01)	-0.44 (-0.93, 0.05)
4	No	0.00	0.00	0.00
	Yes	0.003 (-0.41, 0.41)	0.06 (-0.48, 0.60)	0.10 (-0.67, 0.87)
3	No	0.00	0.00	0.00
	Yes	-0.17 (-0.57, 0.24)	-0.39 (-0.92, 0.13)	-0.42 (-1.16, 0.32)
2	No	0.00	0.00	0.00
	Yes	-0.25 (-0.65, 0.16)	-0.22 (-0.74, 0.29)	-0.34 (-1.07, 0.38)
1 (most deprived)	No	0.00	0.00	0.00
	Yes	-0.23 (-0.63, 0.17)	-0.41 (-0.92, 0.10)	-0.46 (-1.17, 0.25)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

LAD = local authority district

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Fluoridation scheme status was defined as follows: 'Yes': LSOAs where a water fluoridation scheme operated for at least one year in the six years preceding the oral health survey. 'No': LSOAs where a water fluoridation scheme did not operate in any year, and where the average water fluoride concentration was below 0.20 mg/L. Areas with no fluoridation scheme and fluoride concentrations at or above 0.20 mg/L were excluded from the analysis.

Note 4: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 5: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 6: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Dental caries severity score in 5 year olds in 2024

Table A26. Association between drinking water fluoride concentration and experiencing a given category of dental caries severity score, in 5 year olds in 2024, by deprivation group

IMD quintile	Mean fluoride concentration, mg/L	Adjusted beta (95% CI)		
		Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest versus medium, low or zero severity score category
5 (least deprived)	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.12 (-0.31, 0.07)	0.01 (-0.21, 0.23)	0.04 (-0.25, 0.34)
	0.20 to 0.39	-0.08 (-0.29, 0.14)	-0.23 (-0.49, 0.03)	-0.24 (-0.60, 0.11)
	0.40 to 0.69	-0.24 (-0.57, 0.10)	-0.42 (-0.86, 0.03)	-0.45 (-1.06, 0.17)
	≥0.70	-0.31 (-0.59, -0.03)	-0.81 (-1.20, -0.41)	-0.61 (-1.13, -0.10)
	Continuous	-0.04 (-0.09, 0.01)	-0.17 (-0.23, -0.10)	-0.14 (-0.23, -0.05)
4	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.20 (-0.49, 0.10)	-0.07 (-0.42, 0.28)	-0.05 (-0.51, 0.42)
	0.20 to 0.39	-0.18 (-0.51, 0.16)	-0.24 (-0.65, 0.18)	-0.22 (-0.78, 0.34)
	0.40 to 0.69	-0.26 (-0.80, 0.29)	-0.48 (-1.21, 0.24)	-0.66 (-1.68, 0.36)
	≥0.70	-0.27 (-0.71, 0.17)	-0.55 (-1.15, 0.06)	-0.75 (-1.57, 0.07)
	Continuous	-0.03 (-0.11, 0.04)	-0.12 (-0.22, -0.01)	-0.17 (-0.31, -0.02)
3	<0.10	0.00	0.00	0.00
	0.10 to 0.19	0.06 (-0.23, 0.36)	0.10 (-0.25, 0.44)	0.15 (-0.31, 0.60)
	0.20 to 0.39	0.08 (-0.26, 0.42)	-0.11 (-0.52, 0.30)	-0.12 (-0.68, 0.44)
	0.40 to 0.69	-0.19 (-0.72, 0.35)	-0.46 (-1.16, 0.24)	-0.54 (-1.51, 0.43)
	≥0.70	-0.01 (-0.44, 0.43)	-0.33 (-0.92, 0.26)	-0.52 (-1.30, 0.26)
	Continuous	0.02 (-0.09, 0.06)	-0.10 (-0.21, -0.00)	-0.15 (-0.29, -0.02)
2	<0.10	0.00	0.00	0.00
	0.10 to 0.19	0.05 (-0.25, 0.35)	0.02 (-0.32, 0.36)	-0.04 (-0.48, 0.40)
	0.20 to 0.39	-0.03 (-0.37, 0.30)	-0.18 (-0.58, 0.22)	-0.30 (-0.84, 0.24)
	0.40 to 0.69	-0.19 (-0.72, 0.34)	-0.30 (-0.97, 0.38)	-0.58 (-1.51, 0.35)
	≥0.70	-0.22 (-0.65, 0.21)	-0.71 (-1.29, -0.12)	-1.06 (-1.83, -0.29)
	Continuous	-0.05 (-0.13, 0.02)	-0.14 (-0.24, -0.04)	-0.21 (-0.35, -0.08)

IMD quintile	Mean fluoride concentration, mg/L	Adjusted beta (95% CI)		
		Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest versus medium, low or zero severity score category
1 (most deprived)	<0.10	0.00	0.00	0.00
	0.10 to 0.19	-0.21 (-0.50, 0.09)	-0.24 (-0.58, 0.10)	-0.38 (-0.82, 0.05)
	0.20 to 0.39	-0.20 (-0.54, 0.13)	-0.33 (-0.72, 0.07)	-0.55 (-1.08, -0.02)
	0.40 to 0.69	-0.29 (-0.80, 0.23)	-0.63 (-1.29, 0.04)	-0.60 (-1.51, 0.31)
	≥0.70	-0.21 (-0.63, 0.22)	-0.85 (-1.42, -0.28)	-1.27 (-2.02, -0.52)
	Continuous	-0.03 (-0.10, 0.05)	-0.15 (-0.25, -0.05)	-0.22 (-0.35, -0.08)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

LAD = local authority district

mg/L = milligrams per litre

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 4: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 5: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Table A27. Adjusted regression coefficients for the association between fluoridation schemes status and experiencing a given category of dental caries severity score, in 5 year olds in 2022 and 2024, by deprivation group

IMD quintile	Fluoridation scheme	Adjusted beta (95% CI)		
		Low, medium or highest versus zero severity score category	Medium or highest versus low or zero severity score category	Highest versus medium, low or zero severity score category
All	No	0.00	0.00	0.00
	Yes	-0.15 (-0.28, -0.02)	-0.59 (-0.73, -0.45)	-0.83 (-0.99, -0.68)
5 (least deprived)	No	0.00	0.00	0.00
	Yes	-0.19 (-0.41, 0.03)	-0.63 (-0.91, -0.34)	-0.57 (-0.94, -0.19)
4	No	0.00	0.00	0.00
	Yes	0.06 (-0.28, 0.39)	-0.37 (-0.81, 0.07)	-0.27 (-0.88, 0.34)
3	No	0.00	0.00	0.00
	Yes	-0.04 (-0.38, 0.29)	-0.45 (-0.88, -0.02)	-0.64 (-1.22, -0.06)
2	No	0.00	0.00	0.00
	Yes	-0.23 (-0.56, 0.10)	-0.60 (-1.02, -0.17)	-0.92 (-1.49, -0.35)
1 (most deprived)	No	0.00	0.00	0.00
	Yes	-0.14 (-0.47, 0.19)	-0.66 (-1.07, -0.24)	-0.94 (-1.49, -0.39)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

LAD = local authority district

Notes

Note 1: The models were adjusted for deprivation, ethnicity and for residual clustering by local authority district.

Note 2: Mean fluoride concentration was calculated as the mean of annual means in the six years preceding each survey.

Note 3: Fluoridation scheme status was defined as follows: 'Yes': LSOAs where a water fluoridation scheme operated for at least one year in the six years preceding the oral health survey. 'No': LSOAs where a water fluoridation scheme did not operate in any year, and where the average water fluoride concentration was below 0.20 mg/L. Areas with no fluoridation scheme and fluoride concentrations at or above 0.20 mg/L were excluded from the analysis.

Note 4: Severity categories are based on tertiles of non-zero values for the LSOA-level mean d3mft and thresholds are presented in Table 13.

Note 5: Regression coefficients for severity score categories can be interpreted as follows: a negative beta indicates a lower probability of being in a given severity score category or higher relative to all lower categories. A positive beta indicates a higher probability.

Note 6: The continuous fluoride exposure model estimates show the change in effect per interquartile range (0.15 mg/L) increase in fluoride concentration.

Sensitivity analyses

Hip fractures

Table A28. Incidence rates for hospital admissions for hip fractures in people of any age between April 2021 and March 2024, by drinking water fluoride exposure and stratified by fluoridation scheme

Mean fluoride concentration, mg/L	Admissions, N (%)	PYAR, person-years (%)	Incidence per 100,000 PYAR (95% CI)
Fluoridation scheme: Yes			
<0.10	0 (0.0)	1,072 (<0.1)	0
0.10 to 0.19	292 (1.1)	262,075 (1.2)	111 (99, 124)
0.20 to 0.39	1,439 (5.4)	1,144,274 (5.3)	126 (120, 133)
0.40 to 0.69	7,595 (28.4)	5,756,644 (26.7)	132 (129, 135)
≥0.70	17,433 (65.2)	14,407,844 (66.8)	121 (119, 123)
Total	26,759 (100.0)	21,571,908 (100.0)	124 (123, 125)
Fluoridation scheme: No or Natural Fluoridation			
<0.10	81,138 (47.0)	67,945,748 (43.5)	119 (118, 120)
0.10 to 0.19	59,342 (34.4)	61,855,252 (39.6)	96 (95, 97)
0.20 to 0.39	26,889 (15.6)	22,976,953 (14.7)	117 (116, 118)
0.40 to 0.69	4,000 (2.3)	2,783,243 (1.8)	144 (140, 149)
≥0.70	1,156 (0.7)	806,175 (0.5)	143 (135, 151)
Total	172,525 (100.0)	156,367,371 (100.0)	110 (109, 111)
Fluoridation scheme: Missing			
Total	595 (100.0)	671,697 (100.0)	89 (82, 96)

Abbreviations

Mg/L = milligrams per litre

CI = confidence interval

N = number

PYAR = person-years at risk

Notes

Note 1: Mean fluoride concentration is calculated as the mean of annual mean values for the five years prior to the year of the hospital admission.

Note 2: Fluoridation scheme status was defined as follows: 'Yes': LSOAs where a water fluoridation scheme operated for at least one year in the ten years preceding the hospital admission. 'No': LSOAs where a water fluoridation scheme did not operate in any year, and where the average water fluoride concentration was below 0.20 mg/L. 'Natural fluoridation': no fluoridation scheme and fluoride concentrations at or above 0.20 mg/L.

Note 3: Percentages may not sum to the total due to rounding.

Table A29. Adjusted incidence rate ratios for the association between drinking water fluoride per interquartile range (0.15 mg/L) increase in fluoride concentration and emergency hospital admissions for hip fracture in people of all ages between April 2021 and March 2024, by fluoridation scheme status

Fluoridation scheme	Adjusted IRR (95% CI)
Yes	
Continuous	1.01 (0.99, 1.03)
No or Natural fluoridation	
Continuous	1.01 (1.00, 1.03)

Abbreviations

CI = confidence interval

IMD = Index of Multiple Deprivation

IRR = incidence rate ratio

LAD = local authority district

mg/L = milligrams per litre

Notes

Note 1: The model was adjusted for age group, sex, IMD quintile, calendar year and for residual clustering by local authority district.

Note 2: The interquartile range is the difference between the fluoride concentration value at the 25th percentile and at the 75th percentile of the data. This range captures the middle 50% of values.

Note 3: Fluoridation scheme status was defined as follows: 'Yes': LSOAs where a water fluoridation scheme operated for at least one year in the ten years preceding the hospital admission. 'No': LSOAs where a water fluoridation scheme did not operate in any year, and where the average water fluoride concentration was below 0.20 mg/L. 'Natural fluoridation': no fluoridation scheme and fluoride concentrations at or above 0.20 mg/L.

Cognitive ability outcomes in 5 and 7 year olds

Table A30. Distribution of children in the Millenium Cohort Study, by drinking water fluoridation exposure at time of assessment

Mean fluoride concentration, mg/L	Children surveyed at age 5, n (%)	Children surveyed at age 7, n (%)
<0.1	2,972 (38.7)	2,358 (35.2)
0.1 to 0.19	2,535 (29.7)	2,587 (35.8)
0.2 to 0.39	1,382 (19.0)	1,006 (16.3)
0.4 to 0.69	327 (4.7)	285 (4.9)
≥0.7	656 (8.0)	562 (7.7)
Total	7,872 (100.0)	6,798 (100.0)

Abbreviations

mg/L = milligrams per litre

n = number

Notes

Note 1: Annual mean fluoride exposure is taken for the year when the child was assessed (at 5 or 7 years old).

Table A 31. Adjusted regression coefficients for the association between drinking water fluoride per interquartile range increase (0.14 or 0.15 mg/L) in fluoride concentration at age of test assessment and cognitive ability test scores in 5- and 7 year olds in the Millenium Cohort Study

Age at assessment	Cognitive ability test	Difference in test score, Adjusted beta (95% CI)
Age 5	Naming vocabulary (BAS-NV)	0.05 (-0.10, 0.19)
	Pattern construction (BAS-PC)	0.02 (-0.12, 0.16)
	Picture similarities (BAS-PS)	-0.13 (-0.29, 0.03)
Age 7	Word reading (BAS-WR)	0.06 (-0.20, 0.31)
	Pattern construction (BAS-PC)	-0.02 (-0.19, 0.15)
	Progress in maths (NFER PiM)	0.04 (-0.22, 0.31)

Abbreviations

CI = confidence interval

BAS = British Ability Scale

IMD = Index of Multiple Deprivation

IQR = interquartile range

mg/L = milligrams per litre

NFER = National Foundation for Educational Research

OECD = Organization for Economic Cooperation and Development

Notes

Note 1: Annual mean fluoride exposure is taken for the year when the child was assessed (at 5 or 7 years old).

Note 2: Difference in test score is per IQR increase (0.14 mg/L at age 5, 0.15 mg/L at age 7) in drinking water fluoride exposure, adjusted for other common risk factors: age at interview, sex, maternal ethnicity, breastfeeding status, OECD income-weighted quintiles, highest parental academic qualification, sample weights, and clustering. In addition to the common risk factors, each cognitive ability test was adjusted for further factors: BAS-NV (maternal age at childbirth, exposure to smoke, IMD deciles, child started school, speech/language concerns), BAS-PC at age 5 (birthweight, IMD deciles, child started school, speech/language concerns), BAS-PS (birthweight, maternal age at childbirth, speech/language concerns), BAS-WR (birthweight, exposure to smoke, child has special needs), BAS-PC at age 7 (IMD deciles, child has special needs), NFER-PiM (birthweight, maternal age at childbirth, child has special needs). Models also accounted for residual clustering by LSOA.

Table A32. Adjusted regression coefficients for the association between drinking water fluoride per interquartile range increase (0.13 mg/L) in fluoride concentration and cognitive ability test scores in 5 and 7 year olds in the Millenium Cohort Study, excluding children with special needs

Age at assessment	Cognitive ability test	Difference in test score, adjusted beta (95% CI)
Age 7	Word reading (BAS-WR)	-0.04 (-0.27, 0.18)
	Pattern construction (BAS-PC)	0.00 (-0.15, 0.15)
	Progress in maths (NFER PiM)	0.10 (-0.15, 0.34)

Abbreviations

CI = confidence interval

BAS = British Ability Scale

IMD = Index of Multiple Deprivation

IQR = interquartile range

mg/L = milligrams per litre

NFER = National Foundation for Educational Research

OECD = Organization for Economic Cooperation and Development

Notes

Note 1: Annual mean fluoride exposure is taken for the year when the child was aged approximately 9 months old.

Note 2: Difference in test score is per IQR increase (0.13 mg/L) in drinking water fluoride exposure, adjusted for other common risk factors: age at interview, sex, maternal ethnicity, breastfeeding status, OECD income-weighted quintiles, highest parental academic qualification, sample weights, and clustering. In addition to the common risk factors, each cognitive ability test was adjusted for further factors: BAS-WR (birthweight, exposure to smoke, child has special needs), BAS-PC at age 7 (IMD deciles, child has special needs), NFER-PiM (birthweight, maternal age at childbirth, child has special needs). Models also accounted for residual clustering by LSOA.

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